Evaluation of Sorbent Injection for Mercury Control

Quarterly Technical Report
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DISCLAIMER

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ABSTRACT

The power industry in the U.S. is faced with meeting new regulations to reduce the emissions of mercury compounds from coal-fired plants. These regulations are directed at the existing fleet of nearly 1,100 boilers. These plants are relatively old with an average age of over 40 years. Although most of these units are capable of operating for many additional years, there is a desire to minimize large capital expenditures because of the reduced (and unknown) remaining life of the plant to amortize the project. Injecting a sorbent such as powdered activated carbon into the flue gas represents one of the simplest and most mature approaches to controlling mercury emissions from coal-fired boilers.

The overall objective of the test program described in this quarterly report is to evaluate the capabilities of activated carbon injection at four plants with configurations that together represent 78% of the existing coal-fired generation plants. This technology was successfully evaluated in NETL's Phase I tests at scales up to 150 MW, on plants burning subbituminous and bituminous coals and with ESPs and fabric filters. The tests also identified issues that still need to be addressed, such as evaluating performance on other configurations, optimizing sorbent usage (costs), and gathering longer-term operating data to address concerns about the impact of activated carbon on plant equipment and operations. The four sites identified for testing are Sunflower Electric's Holcomb Station, AmerenUE's Meramec Station, AEP's Conesville Station, and Ontario Power Generation's Nanticoke Station.

This is the second quarterly report for this project. This report includes an overview of the plans and progress for the project. Field-testing began during this reporting period. In general, quarterly reports will be used to provide project overviews, project status, and technology transfer information. Topical reports will be prepared to present detailed technical information.

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INTRODUCTION

The overall objective of this test program is to evaluate the capabilities of activated carbon injection at four plants with configurations that together represent 78% of the existing coal-fired generation plants. This technology was successfully evaluated in NETL's Phase I tests at scales up to 150 MW, on plants burning subbituminous and bituminous coals and with ESPs and fabric filters. The tests also identified issues that still need to be addressed, such as evaluating performance on other configurations, optimizing sorbent usage (costs) and gathering longer-term operating data to address concerns about the impact of activated carbon on plant equipment and operations. A summary of the key descriptive parameters for the host sites can be found in Table 2.

The technical approach that will be followed during this program will allow the team to: 1) effectively evaluate activated carbon and other viable sorbents on a variety of coals and plant configurations, and 2) perform long-term testing at the optimum condition for at least one month. These technical objectives will be accomplished by following a series of technical tasks:

Task 1. Design and Fabrication of Sorbent Injection System

Task 2. Site-Specific Activities including Field-Testing (Four Sites)

Task 3. Technology Transfer

Task 4. Program Management and Reporting

Tasks 1, 3, and 4 are intended to support the overall direction, implementation, technology transfer, and management of the program. Task 2 will be repeated for each test site with subtasks designed to address the specific configurations, needs, and challenges of that site. Task 2 is the heart of the program and contains subtasks to address each important component of the testing. A summary of the Field-Testing subtasks (Task 2) is presented in Table 3.

Table 1. Host Site Key Descriptive Information.

	Holcomb	Meramec	Nanticoke	Conesville
Unit	1	1 or 2	5 or 6	5 or 6
Size (MW)	360	140	500	400
Coal	PRB	PRB	PRB	Bituminous
Heating Value (as received)	8,700	8,738	8,840	11,040
Sulfur (% by weight)	0.4	0.25	0.5	2.45
Chlorine (%)	<0.05	0.06	<0.05	0.06–0.16
Mercury (μg/g)	0.056	0.052	0.075	0.16
Particulate Control	Joy Western Fabric Filter	American Air Filter ESP	ESP Joy Western	Research-Cottrell ESP
SCA (ft^2/kacfm)	NA	320	208	301
Sulfur Control	Spray Dryer Niro Joy Western	Compliance Coal	Compliance Coal	Wet Lime FGD
Ash Reuse	Disposal	Sold for concrete	Sold	FGD Sludge Stabilization
Test Portion (MWe)	180 and 360	70	250 and 500	400
Typical Inlet Mercury (μg/dncm)	10–11	10 (estimate)	8–9	15.8
Typical Mercury Removal	0–13%	10–20% (estimate)	35%	56%

A detailed topical report will be prepared at the end of the one-year test period. Quarterly reports will be used to provide project overviews, status, and technology transfer information.

EXECUTIVE SUMMARY

This four-site project is part of an overall program funded by the Department of Energy's National Energy Technology Laboratory (NETL) and industry partners to obtain the necessary information to assess the feasibility and costs of controlling mercury from coal-fired utility plants. Host sites that will be tested as part of this program are shown in Table 1. These host sites reflect a combination of coals and existing air pollution control configurations representing 78% of existing coal-fired generating plants and potentially a significant portion of new plants. These four host sites will allow documentation of sorbent performance on the following configurations:

Table 2. Host Sites Participating in the Sorbent Injection Demonstration Project.

	Coal / Options	**APC**	**Capacity MW / Test Portion**	**Current Hg Removal (%)***
Sunflower Electric's **Holcomb Station**	PRB & Blend	SDA – Fabric Filter	360 / 180 and 360 / 360	0–13
Ontario Power Generation's **Nanticoke Station**	PRB & Blend	ESP	500 / 250 and 500 / 500	35
AmerenUE's **Meramec Station**	PRB	ESP	140 / 70	10–20 (estimate)
American Electric Power's (AEP) **Conesville Station**	Bituminous Blend	ESP + Wet FGD	400 / 400	56

* Based upon recent Ontario Hydro measurements, except Meramec.

During the second reporting quarter, January through March 2004, progress on the project was made in the following areas:

Overall

- Conducted a Team Meeting on March 17, 2004, to present the Holcomb Test Plan to all project participants and review the status of the program. There are currently more than 90 individual team members from 21 organizations participating in this program. Current project co-funders include (* indicates host site):
  - ADA-ES, Inc.
  - ALSTOM
  - AmerenUE* (Meramec Station)
  - American Electric Power* (Conesville Station)
  - Arch Coal
  - Dynegy Generation
  - EPRI
  - MidAmerican
  - NORIT Americas

Ontario Power Generation* (Nanticoke Station) and partners
Epcor
Babcock & Wilcox
Southern Company
Sunflower Electric Power* (Holcomb Station) and partners
Western Fuels Association
Kansas City Board of Public Utilities (KCKBPU)
Westar Energy
Empire District Electric Company
Nebraska Public Power District
Kansas City Power and Light
Tri-state/Missouri Basin Power Project
Wisconsin Public Service

- Key members of the test team include:
  ADA-ES
  ALSTOM
  EPRI
  NORIT Americas
  Reaction Engineering International
  Tetra Tech, Inc.
  Others
  Stack test firms
  Analytical laboratories
- To facilitate information sharing, a project Web site was prepared and launched during the team meeting. The project Web site is password protected and available only to project participants. Information available through the Web site includes all presentations, papers, reports, planning documents, schedules and other information related to the project.

Sunflower Electric Power Corporation, Holcomb Station

- Issued a final Test Plan.
- Submitted a Sample and Data Management Plan.
- Submitted Host Site and Cost-Share Agreements to Sunflower Electric.
- Issued invitations to sorbent producers and developers to submit sorbent samples for testing.
- Finalized the logistics associated with the coal blending tests.
- Finalized source testing protocol (e.g., M29, M26a, Ontario Hydro) to be conducted during the baseline and long-term testing series.
- Finalized design for sorbent injection system.
- Issued fabrication drawings for sorbent injection lances and manifold.
- Issued an Equipment Installation document.
- Installed foundation for sorbent injection system.
- Finalizing equipment required for coal additive tests included in the parametric test period.
- Finalized design and fabrication of sorbent screening device.
- Conducted sorbent screening tests between February 23 and March 2, 2004.

AmerenUE, Meramec

- Submitted Host Site Agreement to AmerenUE.
- Conducted a site visit to finalize location of sampling and injection ports and discuss project plans with plant personnel.
- Plant personnel installed new ports in March.
- Submitted foundation loads and design notes associated with the sorbent injection system.
- Developed a draft Test Plan to be presented to AmerenUE personnel during a site kickoff meeting scheduled for April.

American Electric Power (AEP), Conesville

- Host Site Agreement under review by ADA-ES and AEP.
- Conducted a site visit to inspect ductwork at proposed sorbent injection location.

Ontario Power Generation (OPG), Nanticoke

- Host Site Agreement under review by ADA-ES and OPG.

EXPERIMENTAL

The overall objective of this test program is to evaluate the capabilities of activated carbon injection at four plants with configurations that together represent 78% of the existing coal-fired generation plants. Following the technical approach summarized in this section, ADA-ES and the project team will evaluate activated carbon and other viable sorbents on a variety of coals and plant configurations, and perform long-term testing at the optimum condition for up to six weeks. The technical approach is outlined in a series of four technical tasks:

Task 1. Design and Fabrication of Sorbent Injection System

ADA-ES, the primary test contractor, will provide the majority of the process equipment that will travel from site to site. This equipment will be sized and designed to cover the expected range of plant sizes (70–500 MW) and flue gas conditions, and has the flexibility for both baghouse and ESP applications.

Task 2. Site-Specific Activities Including Field-Testing

This task has seven subtasks that will be repeated for the four host sites. A summary of these subtasks is presented in Table 3. The four sites identified for testing are Sunflower Electric's Holcomb Station, AmerenUE's Meramec Station, AEP's Conesville Station, and OPG's Nanticoke Station. A description of each host site is included below.

Table 3. Task 2 Subtasks (to be repeated at each test site).

Subtask	Description
2.1	Host site kickoff meeting, Test Plan, and QA/QC plan
2.2	Design and install site-specific equipment
2.3	Field-tests
2.3.1	Sorbent selection
2.3.2	Sample and data coordination
2.3.3	Baseline tests
2.3.4	Parametric tests
2.3.5	Long-term tests
2.4	Data analysis
2.5	Sample evaluation
2.6	Economic analysis
2.7	Site report

Sunflower Electric's Holcomb Station, Unit 1

Holcomb Station is located near Garden City, Kansas. The unit is a load-following sub-critical 360-MW pulverized coal opposed-fired Babcock & Wilcox Carolina-type radiant boiler designed to burn PRB coal. The existing unit is equipped with three spray dry absorber (SDA) modules followed by two very low air/cloth ratio reverse air fabric filters.

Tests are scheduled to evaluate the effectiveness of sorbents injected both upstream and downstream of the SDA. For activated carbon injection testing with injection upstream of the spray dryer, the entire 360-MW unit will be evaluated. For injection downstream of the SDA, sorbent will be injected into one fabric filter module (180 MW). Additional testing will include: 1) the effect of blending the PRB coal with 10% to 15% bituminous coal on baseline mercury removal (no sorbent injection), and 2) the effectiveness of introducing additives to the coal to enhance both baseline mercury removal performance and the performance of non-chemically treated activated carbon, and 3) the effectiveness of enhanced sorbents.

Ontario Power Generation's Nanticoke Generating Station

Nanticoke Generating Station is located on the north shore of Lake Erie near Hamilton, Ontario, Canada. Nanticoke is one of the largest coal-fired facilities in the world with a generation capacity of 4,000 MW across eight 500-MW units. The boilers are B&W-designed PC units that normally fire a blend of PRB and low-sulfur eastern bituminous coals. Boiler flue gas passes through an air preheater and ESP before venting through the stack. This unit provides the opportunity to evaluate an ESP with an SCA of nominally 210 ft^2/kacfm.

Tests are scheduled to evaluate the effectiveness of sorbents injected upstream of the ESP at Nanticoke. During most of testing, the plant will be burning 100% PRB coal. Tests are also scheduled to assess the effectiveness of blending PRB with bituminous coal. Sorbent testing will include the benchmark sorbent, NORIT DARCO FGD, and up to two alternative sorbents. Nanticoke typically sells its fly ash and considerations will be made when selecting sorbents towards those that may not impact sales. In addition, to minimize the potential loss of ash sales during the test program, the long-term tests will be kept to the minimum allowable duration. The 50-MW unit is split downstream of the sorbent injection location. However, because of the duct configuration, it is difficult to precisely inject into only half of the unit. Some tests will be conducted to determine the effectiveness of lances designed to treat one-half of the unit (250 MW) rather than the entire unit (500 MW). Because of the unit size, the sorbent costs are a significant fraction of the overall costs for this site and funding is not available to treat the entire 500 MW for the long-term test.

AmerenUE's Meramec Unit 2

AmerenUE's Meramec Plant is located in St. Louis County, Missouri. Unit 2 is a load-following, sub-critical 140-MW (gross) pulverized coal, tangentially fired, steam-electric generating unit that operates at a 60% capacity factor. The unit fires 100% subbituminous PRB coal. The unit is equipped with an ESP for particulate removal with an SCA of nominally 320 ft^2/kacfm. During the 2004 spring outage, the unit was retrofitted with low-

NO_x burners and separated overfire air for control of NO_x emissions. For PAC injection testing with injection upstream of the ESP, only one-half of the flue gas stream will be evaluated.

Mercury testing has previously been conducted at Meramec Plant and these results were included in the ICR data. However, this testing was conducted prior to the station's decision to fuel switch entirely over to 100% PRB coal. Therefore, some testing would be necessary over the next several months to establish a representative baseline. In lieu of actual test data, we currently base our assumptions on ICR data for similar generating units that combust PRB coal with a medium-size ESP as a representative estimate of the current mercury emissions from these units.

Tests are scheduled to evaluate the effectiveness of sorbents injected upstream of the ESP at Meramec. During testing, the plant will be burning 100% PRB coal. Sorbent testing will include the benchmark sorbent, NORIT DARCO FGD, and up to two alternative sorbents. Alternative sorbents will be selected by the team based upon cost and performance.

Although the ash from Unit 2 can be collected and disposed of separately from ash from the other units, the ash is sometimes sold and the plant has requested that the duration of testing be kept to a minimum to limit lost ash-sales revenues. Therefore, sorbents that will not affect ash sales (non-carbon based) will be considered and the long-term test period will be limited to one month.

AEP's Conesville Unit 5 or 6

AEP Conesville Units 5 and 6 are sister 400-MW T-fired units located in Conesville, Ohio. The boilers are Combustion Engineering (ALSTOM) designed PC units that normally fire high-sulfur eastern bituminous coal. The units are each equipped with cold-side Research-Cottrell ESPs. Flue gas is drawn through the ESPs via ID fans. In each unit, the ID fans discharge flue gas into two Universal Oil Products wet lime absorber modules. The modules have partial bypass capability and have been retrofitted with a B&W tray design. Testing is planned for one 400-MW unit.

Tests are scheduled to evaluate the effectiveness of sorbents injected upstream of the ESP at Conesville. During most of testing, the plant will be burning 100% eastern bituminous coal. Tests are also scheduled to assess the effectiveness of blending bituminous coal with PRB coal. Sorbent testing will include the benchmark sorbent, NORIT DARCO FGD, and up to two alternative sorbents. Mercury will be monitored at the outlet of the ESP and the outlet of the scrubber to determine if any sorbent materials increase the mercury removal across the entire system, as may occur if a sorbent increases the fraction of oxidized mercury.

Subtask 2.1. Host Site Planning and Coordination

Efforts within this subtask include planning the site-specific tests with the host site utility, DOE/NETL, and contributing team members. The planning process includes meeting with plant personnel, corporate, and environmental personnel to discuss and agree upon the overall scope of the program, the potential impact on plant equipment and operation, and to gather preliminary information necessary to develop a detailed draft Test Plan and scope of work. Efforts include identifying any permit requirements, developing a quality

assurance/quality control plan, finalizing the site-specific scope for each of the team members, and putting subcontracts in place for manual flue gas measurements, including Ontario Hydro mercury measurement services.

A key component of the planning process for these evaluations is identifying potential sorbents for testing. The test program at each site allows for the evaluation of different sorbents because of the economic impact of sorbent cost on the overall cost of mercury control and disposal considerations. In addition, sorbents that have the potential to capture mercury at the low HCl conditions typical of subbituminous units, especially those with upstream spray dryers such as Holcomb, will be evaluated.

Subtask 2.2. Design, Fabricate, and Install Equipment

During this subtask, equipment will be identified, designed, fabricated when necessary, and installed at the host site. Some components are site-specific such as the sorbent distribution manifold and sorbent injectors (if possible these components will be reused at multiple sites). This equipment must be sized, designed, and fabricated for the specific plant arrangements and ductwork configurations. Required site support includes installation of the injection and sampling ports (if not available), installation of required platforms and scaffolding, compressed air, electrical power, wiring plant signals including boiler load to the injection skid and control trailer, and the balance of plant engineering. The host utility will be responsible for all permitting and any variance requirements.

Subtask 2.3. Field-Tests

The field-tests will be accomplished through a series of five (5) steps. A summary of these steps is presented below.

2.3.1 Sorbent Selection:

Prior to the start of equipment installation, sorbents will be selected for evaluation during the parametric tests. At some sites, due to the plant configuration and availability of sorbent performance data, sorbent screening tests will be conducted on a slipstream of gas from the host site. For example, limited data were available to compare sorbent performance on units firing PRB and configured with spray dryers and fabric filters. Therefore, screening tests were scheduled for Holcomb Station. Data are available to compare the potential performance of sorbents for units firing PRB coal with ESPs installed for particulate control. Screening tests will be conducted at Nanticoke or Meramec only if available data are not sufficient to select appropriate materials for the parametric testing period.

2.3.2 Sample and Data Coordination:

ADA-ES engineers will coordinate with plant personnel to retrieve the necessary plant operating data files and determine appropriate samples to collect during baseline, parametric, and long-term testing periods. These data will be used to prepare a Sample and Data Management Plan for the site. The plant data will be integrated into the sorbent injection and mercury control data.

2.3.3 Baseline Testing:

Once the equipment is installed, a set of baseline tests will be conducted just prior to the parametric testing. Unit operation will be set at conditions expected during the parametric tests. It is anticipated that boiler load will be held constant at full-load and that the air pollution equipment will be operated under standard full-load conditions (standard soot blowing, baghouse cleaning logic, spray dryer recycle, ESP rapping, etc., will be used). Ontario Hydro mercury measurements, as well as other tests identified in the Test Plan such as EPA M26a, will be conducted in conjunction with SCEM measurements during this step.

For sites with the ability to co-fire with a blend of bituminous and PRB coals, tests will be conducted to measure the effect of blending on both mercury removal and speciation across the particulate control devices. Mercury measurements will be made using only the SCEMs.

2.3.4 Parametric Tests:

The goals of this step are to define the quantity of sorbent required to obtain different levels of mercury removal, such as 60%, 80%, and 90% of the remaining mercury. Additional parametric testing, such as the effect of introducing additives to the coal, are included during the parametric tests at some sites. Up to four weeks of parametric testing will be conducted, depending on the host site Test Plan. A condition is typically tested for about 8 hours, and then the system is shut down and allowed to return to baseline conditions before the next parametric test.

2.3.5 Long-Term Testing:

Long-term testing will be conducted at the "optimum" settings as determined in the parametric tests and approved by both DOE and the host utility. It is the intent of DOE that these settings represent the maximum mercury removal. The goal of this step is to obtain sufficient operational data on removal efficiency over a 4- to 6-week period, the effects on the particulate control device, the effects on the sulfur control equipment, effects on byproducts, and impacts to the balance of plant equipment to prove viability of the process and determine the economics. During this test, Ontario Hydro measurements will be conducted at the inlet and outlet of the pollution control device(s) at least once, depending on results verifying SCEM measurements during the baseline tests.

Subtask 2.4. Data Analysis

Data collection and analysis for this program is designed to measure the effect of sorbent injection on mercury control and the impact on the existing pollution control equipment. The mercury levels and plant operation will be characterized without sorbent injection, during coal blending or coal additive testing (when applicable), and with various injection rates and possible combustion modifications as defined by the final Test Plan, and a long-term evaluation to identify effects that may not be immediate.

Subtask 2.5. Coal and Byproduct Evaluation

Coal and combustion byproduct samples collected throughout the field-test will be analyzed in this task. During all test phases, samples of coal, fly ash, and scrubber waste will be collected. Ultimate and proximate analyses will be performed and mercury, chlorine, and

sulfur levels will be determined. Activated carbon injection will result in the fly ash and scrubber materials being mixed with a certain amount of the mercury-containing sorbent. The ash samples will be analyzed at a minimum for mercury and LOI. Scrubber feed limestone, solids product discharge, and blowdown will be analyzed for mercury. Because of the apparent influence of HCl on sorbent effectiveness, HCl measurements will be conducted and samples analyzed to determine if there is a correlation between sorbent effectiveness and HCl concentrations.

Standard leaching test methods will include the Toxicity Characteristic Leaching Procedure (TCLP, SW846-1311) and synthetic groundwater leaching procedure (SGLP).

Analytical tests to determine if the ash is suitable for use in concrete will be conducted at Nanticoke and Meramec. Tests are conducted to evaluate properties under ASTM Specification C618, which include chemical and physical property analysis. Air entrainment shaker tests will also be performed as part of the concrete suitability test series.

A site report will be prepared documenting measurements, test procedures, analyses, and results obtained in Task 2. This report is intended to be a stand-alone document providing a comprehensive review of the testing that will be submitted to the host utility.

Subtask 2.6. Economic Analysis

After completion of testing and analysis of the data at each plant, the requirements and costs for full-scale permanent commercial implementation of the selected mercury control technology will be determined. The ADA-ES/ALSTOM program team will meet with the host utility plant and engineering personnel to develop plant-specific design criteria. Process equipment will be sized and designed based on test results and the plant-specific requirements (reagent storage capacity, plant arrangement, retrofit issues, winterization, controls interface, etc.). A conceptual design document will be developed. Finally, a budget cost estimate will be developed to implement the control technology.

Subtask 2.7. Site Report

A site report will be prepared documenting measurements, test procedures, analyses, and results obtained in Task 2. This report is intended to be a stand-alone document providing a comprehensive review of the testing that will be submitted to the host utility.

Task 3. Technology Transfer

Technology transfer activities include participation in DOE/NETL-sponsored meetings, EPA Hg MACT Stakeholder meetings, presentations at conferences, and publication of technical papers.

Task 4. Program Management and Reporting

The final task provides time for overall program management and time to complete DOE's reporting requirements. This task will also support periodic meetings with DOE to discuss progress and obtain overall direction of the program from the DOE project manager. In addition to the standard financial and technical reports, additional deliverables will include topical reports for each site tested.

RESULTS AND DISCUSSION

Task 1. Design and Fabrication of Sorbent Injection System

Design of the sorbent injection system was completed during the second reporting period—January through March 2004. The redesigned sorbent injection system has a 2,500 ft^3 storage capacity, which is capable of holding approximately 40,000 lbs of sorbent material. The system is also equipped with dual feeder/blower assemblies capable of accurately delivering 0–1,000 lbs/hr to the desired injection location. Other new features include variable speed blowers, silo load cells, increased efficiency vent filter, and Ethernet connectivity for remote monitoring.

Task 2. Site-Specific Activities Including Field-Testing

Initial field-testing is underway at Holcomb Station. Preliminary site-specific activities have begun at the other three sites. Summaries of site-specific activities that have been completed or progressed during this quarter are included under this task heading. Initial results are also presented when available.

Sunflower Electric Power Corporation, Holcomb Station

Subtask 2.1. Host Site Planning and Coordination

- Submitted Host Site and Cost-Share Agreements to Sunflower Electric.
- Issued a final Test Plan.
- Submitted a Sample and Data Management plan. The team has decided to collect multiple samples throughout the process stream so that samples will be available if analyses are required. The Sample and Data Management plan was developed to assist the team with sample collection, record keeping (including logging samples and results from analyses), and sample storage.
- Issued invitations to sorbent producers and developers to submit sorbent samples for testing. Sorbent vendors and developers were invited to submit a small sample of sorbent for slipstream testing at Holcomb Station. The project team reviewed information submitted by interested parties.
- Finalized the logistics associated with the coal blending tests. Holcomb Station typically burns 100% PRB coal. Project support was required to coordinate with the coal mine (Arch Coal, West Elk mine) and the to explore feasible transportation options (rail or truck). Additional cost-share from Arch Coal was also negotiated to help offset the unexpected costs of coordinating and delivering Western Bituminous coal to Holcomb. An unsuccessful attempt was also made to arrange for a shipment of eastern bituminous coal to the plant.
- Reviewed results from sorbent screening tests and identified two alternative sorbents to be tested during the parametric test period. Selection was based upon screening

test results, price, availability, and potential secondary concerns (including leaching of chemicals used to treat activated carbon).
- Finalized source testing protocols (e.g., M29, M26a, Ontario Hydro) to be conducted during the baseline and long-term testing series.

Subtask 2.2. Design, Fabricate, and Install Site-Specific Equipment

- Finalized design for sorbent injection system.
- Issued an Equipment Installation document to site personnel.
- Installed foundation for sorbent injection system.
- Issued fabrication drawings for sorbent injection lances and manifold
- Finalizing equipment arrangement to be used for coal additive tests included in the parametric test period.
- Finalized the design and fabricated the sorbent screening device.

Subtask 2.3. Field-Tests

- Conducted sorbent screening tests between February 23 and March 2, 2004. The slipstream sorbent test device was designed to simulate the flowrate and projected sorbent and ash loading across the fabric filter at Holcomb. A sorbent and ash mix was pre-loaded onto a standard sampling filter at the representative loading for the filtering cycle. Flue gas was extracted from the fabric filter inlet and the slipstream device was operated at the full-scale fabric filter temperature and air-to-cloth ratio for the duration of the test. Results from these tests were used to select two alternative sorbents for full-scale parametric tests.
    - More than 20 sorbents from 10 different suppliers for slipstream testing. Suppliers included: Barnebey Sutcliffe/Calgon, Carbo Chem, Columbia Chemical, Donau, General Technologies, ISGS, NORIT, RWE, Sorbtech, Superior Adsorbents.
    - Results from sorbent screening tests indicated that several sorbent options performed better than the benchmark sorbent, DARCO FGD. Top performers included various halogen-treated activated carbon (iodine, bromine or chlorine), and high-activity non-chemically treated activated carbon materials. One non-carbon based sorbent also demonstrated promise. Iodine sorbents were not chosen for full-scale testing because of the high sorbent costs and post-landfill leaching concerns. Two non-iodine, halogen-treated materials, one from Sorbtech and one from NORIT Americas, demonstrated similar promising performance. According to cost projections provided by the manufacturers, the commercial costs of these currently experimental products would be similar and both nominally 50% higher than the benchmark NORIT DARCO FGD. The NORIT product, FGD-E3, was chosen as one of the materials for the parametric tests. Sorbtech was not able to provide material in time for the parametric tests. The second material chosen for parametric testing at Holcomb was a non-chemically treated material from Barnebey Sutcliffe/Calgon.

AmerenUE, Meramec

- Conducted a site visit.
- Determined appropriate locations for new test ports. Plant personnel installed the new ports on east side of Unit 2.
- ADA-ES submitted foundation loads and design notes associated with the sorbent injection system to Meramec personnel.
- Submitted Host Site Agreement to AmerenUE for review.
- Prepared a draft test plan to be finalized during the next quarter.

American Electric Power (AEP), Conesville

- Host Site Agreement under review by ADA-ES and AEP.
- Met with plant personnel to discuss appropriate sorbent injection options. Conducted a visual inspection during a plant outage to determine the arrangement of baffles, turning vanes, and bracing downstream of injection.

Ontario Power Generation (OPG), Nanticoke

- Host Site Agreement under review by ADA-ES and OPG.

Task 3. Technology Transfer

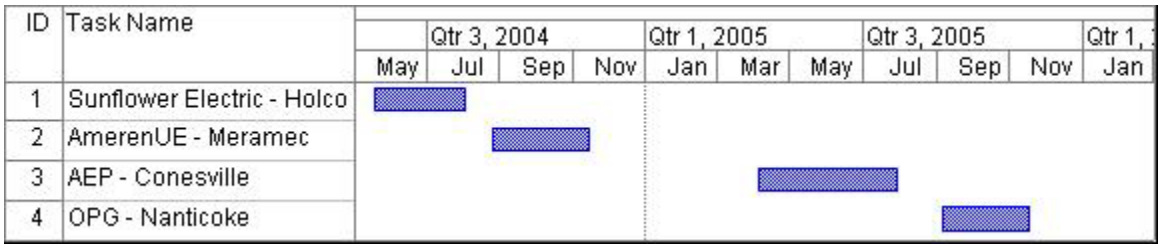
Abstracts were submitted to several upcoming conferences including the Mega Symposium and the Low-Rank Fuels Conference. Presentation of results from tests conducted at Holcomb are planned.

Task 4. Program Management and Reporting

- Conducted a Team Meeting on March 17, 2004, to present the Holcomb Test Plan to all project participants and review the status of the program. There are more than 90 individual team members from 21 organizations participating in this program. Current project co-funders include (* indicates host site):
    - ADA-ES, Inc.
    - ALSTOM
    - AmerenUE*
    - American Electric Power*
    - Arch Coal
    - Dynegy Generation
    - EPRI
    - MidAmerican
    - NORIT Americas
    - Ontario Power Generation* and partners
        - Epcor
        - Babcock & Wilcox
    - Southern Company
    - Sunflower Electric Power* and partners
        - Western Fuels Association
        - Kansas City Board of Public Utilities (KCKBPU)

Westar Energy
Empire District Electric Company
Nebraska Public Power District
Kansas City Power and Light
Tri-State/Missouri Basin Power Project
Wisconsin Public Service

- Key members of the test team include:
  - ADA-ES
  - ALSTOM
  - EPRI
  - NORIT Americas
  - Reaction Engineering International
  - Tetra Tech, Inc.
  - Others
    - Stack test firms
    - Analytical laboratories
- To facilitate information sharing, a project Web site was prepared and launched during the team meeting. The project Web site is password protected and available only to project participants. Information available through the Web site includes all presentations, papers, reports, planning documents, schedules and other information related to the project.
- Following is a preliminary field-testing schedule for all four sites:



CONCLUSIONS

None this reporting period.

REFERENCES

None this reporting period.

LIST OF ACRONYMS AND ABBREVIATIONS

ACI	Activated carbon injection
APC	Air pollution control
B&W	Babcock & Wilcox
DOE	Department of Energy
ESP	Electrostatic precipitator
FGD	Flue gas desulfurization
ID Fan	Induced draft fan
kacfm	Thousand actual cubic feet per minute
kW	Kilowatt
MW	Megawatt
NETL	National Energy Technology Laboratory
O&M	Operating and Maintenance
PC	Pulverized coal
PRB	Powder River Basin
SCA	Specific collection area
SCEM	Semi-continuous emission monitor
SDA	Spray dryer absorber
SGLP	Synthetic groundwater leaching procedure
TCLP	Toxicity characteristic leaching procedure